

Claims

What is claimed is:

- 1           1.       A method for determining the angular orientation of an object  
2           comprising:  
3                 obtaining a plurality of images of the object;  
4                 assigning values to a plurality of positions in a polar plot using data  
5           from the images wherein the polar plot has an origin; and  
6                 computing a centroid based on the assigned values wherein an angle of  
7           the centroid with respect to the origin indicates the angular orientation of the  
8           object.
- 1           2.       The method according to claim 1, wherein said assigning comprises  
2           identifying positions in the polar plot that are uniformly spaced, identifying  
3           corresponding pixels in the image for the positions in the polar plot and  
4           assigning luminance values for the pixels to the positions in the polar plot.
- 1           3.       The method according to claim 2, wherein said assigning further  
2           comprises interpolating for positions in the polar plot that are between pixels.
- 1           4.       The method according to claim 1, wherein said assigning results in a  
2           non-linear mapping of pixel position to polar position.
- 1           5.       The method according to claim 1, further comprising determining a  
2           width of the object by scanning each image.
- 1           6.       The method according to claim 1, further comprising calibrating  
2           cameras prior to obtaining the images from the cameras.
- 1           7.       The method according to claim 6, wherein said calibrating comprises  
2           obtaining images of a cylindrical object of uniform color.

1        8.        The method according to claim 1, wherein the plurality of images  
2 consists of four images taken by each of four cameras and wherein said  
3 assigning includes assigning one of the images to each of four quadrants of the  
4 polar plot.

1        9.        The method according to claim 1, wherein the plurality of images  
2 consists of three images taken by each of three cameras and wherein said  
3 assigning includes assigning one of the images to each of three 120 degree  
4 intervals of the polar plot.

1        10.       The method according to claim 1, the polar plot is divided into sectors  
2 with an image of the plurality being obtained for each sector and with all  
3 sectors of the polar plot being imaged.

1        11.       The method according to claim 1, wherein said images are obtained  
2 from near-infrared light from the object.

1        12.       The method according to claim 1, further comprising determining a  
2 location of the object in the field of view of each of a plurality of cameras and  
3 when the object is not in the center of the field of view, said assigning is  
4 corrected according to its distance from the center.

1        13.       The method according to claim 1, wherein the object is a person's  
2 head.

1        14.       The method according to claim 13, further comprising directing the  
2 person's voice at a remote location according to the angular orientation of the  
3 person's head.

1        15.       The method according to claim 13, further comprising estimating a  
2 vertical position of the person's eyes and obtaining luminance values of the  
3 images at or below the level of the person's eyes.

1        16.     The method according to claim 15, wherein said estimating comprises  
2 scanning the images to locate the top of the person's head and measuring a  
3 distance down from the top of the person's head.

1        17.     The method according to claim 15, wherein said estimating comprises  
2 scaling the images.

1        18.     The method according to claim 13, further comprising performing a  
2 180 degree correction of angular orientation of the person's head.

1        19.     The method according to claim 13, further comprising displaying  
2 images of a remote location for the person.

1        20.     The method according to claim 13, wherein said images are formed by  
2 performing difference keying.

1        21.     The method according to claim 20, wherein said images are obtained  
2 from near-infrared light from the person's head.

1        22.     The method according to claim 20, wherein said performing difference  
2 keying includes subtracting a baseline image of an apparatus from an image  
3 obtained with the person's head being located within the apparatus.

1        23.     The method according to claim 22, wherein the apparatus comprises  
2 projection screens that substantially surround the person.

1        24.     The method according to claim 1, wherein the luminance values  
2 assigned to the polar plot are obtained from a band around the object that is  
3 one pixel wide.

1        25.     The method according to claim 1, wherein the values assigned to the  
2 polar plot are luminance values obtained from a band around the object that is  
3 multiple pixels wide.

1        26.     The method according to claim 25, wherein the luminance values  
2        assigned to the polar plot represent a vertical average.

1        27.     The method according to claim 25, wherein said assigning further  
2        comprises performing bi-linear interpolation for positions in the polar plot that  
3        are between pixels.

1        28.     The method according to claim 1, wherein the values assigned to the  
2        polar plot represent vertical luminance variance.

1        29.     The method according to claim 1, wherein the values assigned to the  
2        polar plot represent vertical frequency content.

1        30.     A program storage device readable by a machine, tangibly embodying  
2        a program of instructions executable by the machine to perform method steps  
3        for determining the angular orientation of an object, said method steps  
4        including obtaining a plurality of images of the object, assigning values to a  
5        plurality of positions in a polar plot using data from the images wherein the  
6        polar plot has an origin, and computing a centroid based on the assigned  
7        values wherein an angle of the centroid with respect to the origin indicates the  
8        angular orientation of the object.

1        31.     A system for determining the angular orientation of an object  
2        comprising:  
3                a plurality of cameras for obtaining a plurality of images of the object;  
4        and  
5                a computer for assigning values to a plurality of positions in a polar  
6        plot using data from the images wherein the polar plot has an origin and the  
7        computer for computing a centroid based on the assigned values wherein an  
8        angle of the centroid with respect to the origin indicates the angular orientation  
9        of the object.